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AN INTEGRATED MODEL OF THE THEORY OF PLANNED BEHAVIOR AND VALUE-BELIEF-NORM FOR PREDICTING STUDENTS' ENERGY-SAVING BEHAVIOR

Bireswar Dutta

Abstract. *Sustainable campus development has become a critical issue for higher education institutions worldwide. Motivating students to develop energy-saving behaviors is considered one of the most effective courses of action, as it ultimately leads to a sustainable campus and lower energy use. Thus, the current study developed a framework based on the Theory of planned behavior (TPB) and Value-belief norm (VBN) to examine the biospheric, altruistic, and egoistic values that encourage students to participate in energy-saving activities, contributing to the development of a sustainable campus. Structural equation modeling was utilized to evaluate the proposed framework using 411 valid responses. The results demonstrated that the proposed framework (R^2 = .681) outperformed both VBN (R^2 = .449) and TPB (R^2 = .498) in predicting students' intentions to engage in energy-saving behavior. Energy-saving communication was also found to be a critical moderator between the students' intention and their predictors. The results indicate that university administrations should develop a more effective approach to communicate the social and personal benefits of energy-saving behavior, thereby optimizing its advantages. The study findings contribute to the critically important and continuously expanding literature on developing sustainable campuses through pro-environmental behaviors.*

Keywords: *sustainability, energy-saving behavior, sustainable campus, value-belief norm, theory of planned behavior.*

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Introduction

The persistent rise in energy consumption linked to technology is rendering energy a more critical concern. The substantial energy consumption and greenhouse gas emissions associated with energy production exacerbate climate change, a progressively crucial environmental concern (Leal Filho et al., 2023). Emissions of greenhouse gases into the atmosphere globally have risen incrementally (Shivanna, 2022). The Intergovernmental Panel on Climate Change (IPCC) has stated that global environmental change negatively affects ecosystems, human health, and economic prospects (Shivanna, 2022). Energy-efficient methods are crucial in residential, occupational, and educational settings, particularly in universities (Leal Filho et al., 2023). Universities need to prioritize energy conservation due to its beneficial impacts on both the campus and the surrounding community (Heib et al., 2023). Energy savings can be achieved in two ways: either by adopting more energy-efficient technologies, such as upgrading the lighting system to LED lights, or by changing behavior, such as shutting off computers and lights when not in use (Pedro et al., 2025). The institution may employ both technical and behavioral strategies to reduce energy usage. A potential obstacle may be the expenses associated with technological upgrades. Behavioral modifications often incur little or no cost (Tian et al., 2022).

Literature identifies primarily two factors influencing energy-use practices: (1) Demographic variables, encompassing age, gender, number of offspring, household income, marital status, and educational attainment (Pedro et al., 2025; Tian et al., 2022; Ylaya & Malicay, 2022); and (2) Psychological variables, generally considered the paramount predictors of energy consumption behaviors, including attitudes, subjective norms, perceived behavioral control, personal values, environmental responsibility, individual norms and awareness of energy conservation and (Leal Filho et al., 2023; Lin et al., 2022). The literature further indicates several factors that affect behavioral changes (Ma, 2022; Xing et al., 2022). Ma (2022) has found that students' energy-saving behaviors may be influenced by their socio-demographic characteristics. Janmaimool and Chontanawat (2021) have also indicated that an effective energy education program in Greece, which instructs children

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and parents on energy-related issues, can lead to energy-saving behaviors. Ren et al. (2022) have suggested that one of the crucial approaches for schools to reduce energy use is to cultivate a "conservation culture" by educating students on energy-related activities. Thus, previous studies have suggested that lecturers and administrators can influence students' conservation behaviors and energy-related issues (Janmaimool & Chontanawat, 2021; Ma, 2022).

Understanding students' energy-saving behaviors is critical for creating a sustainable campus. Their participation in energy-saving initiatives affects both current energy use behaviors and indicates future trends (Leal Filho et al., 2023). Prosocial or self-interested incentives are often seen as the key catalysts for individuals' pro-environmental objectives (De Dominicis et al., 2017; Han, 2015). De Groot and Steg (2009) have characterized pro-environmental acts as activities that aid others, such as providing assistance, sharing resources, and collaborating, sometimes at a personal cost to the individual involved. The energy-saving habits of students contribute to the university's goal of becoming a sustainable community and align with its objective of achieving a sustainable campus. Han (2015) has emphasized that enhancing students' intentions becomes a pivotal issue for the progression of educational research.

Literature has highlighted that people's environmentally aware intentions and activities, driven by prosocial motivations, often utilize the VBN framework (Han, 2015; Stern et al. 1999). Studies have asserted that self-interest motivates environmentally aware intentions and actions, often employing rational-choice models, such as the Theory of Reasoned Action (TRA) or the Theory of Planned Behavior (TPB) (Ajzen, 1991; Fishbein & Ajzen, 1977). While energy-saving activity is associated with benevolence and termed "altruistic behavior" (Thelken & de Jong, 2020). Students' motivation to participate in pro-environmental initiatives is influenced by both egoism and personal values, prompting them to explore novel endeavors while contributing to environmental conservation. At the same time, they discuss environmental concerns with their educators and peers and collaborate to create a sustainable environment (Han, 2015). Wang et al. (2021) have emphasized that effective communication and students' psychological values, like biospheric, altruistic, and egoistic, promote their participation in energy-saving activities. Li et al. (2023) have found that integrating prosocial behaviors with energy conservation efforts fulfills students' psychological needs and increases their desire to engage in energy-saving practices. Yusliza et al. (2020) have argued that an inclusive interpretation of students' pro-environmental behavior requires incorporating the altruistic aspects of human psychology, which include self-enhancement and the acquisition of pro-environmental behaviors.

Literature has established the efficacy of the TPB in promoting environmentally aware behavior (Dutta & Hwang, 2021; Heib et al., 2023) and the suitability of the VBN theory for analyzing prosocial incentives (De Groot & Steg, 2010). The findings of these studies collectively enhance our understanding of individuals' pro-environmental engagement. However, the applicability of the theories in accurately comprehending pro-environmental behavior has often been questioned (Ghazali et al., 2019; Shafiei & Maleksaeidi, 2022). To the researcher's knowledge, no study integrates these two theoretical aspects into a singular analysis of students' intentions to cultivate sustainable campuses through energy-conserving behaviors.

A key recognition about prosocial behavior is that the degree of energy-saving communication mediates students' engagement (Abbas et al., 2019; Hirani et al., 2022). Students' decision-making processes alter based on the knowledge of environmental actions (Abbas et al., 2019). While literature indicates that communication is no longer a reliable and direct predictor of behavior (Abbas et al., 2019; Chao, 2019), it remains an essential approach for overcoming fundamental psychological obstacles. Communication is instrumental in mitigating barriers such as deceit and ignorance (Chao, 2019; Hirani et al., 2022). Specifically, it addresses the challenge of making informed, sustainable judgments when precise information is absent. Remarkably, no studies have investigated how energy-efficient communication may promote pro-environmental behavior or leverage a prosocial objective to foster a sustainable campus through students' energy-conserving practices.

Theoretical Background

Sustainable Energy Behaviors

Sustainable energy behaviors (SEBs) are acts that lead to reduced energy consumption or enhanced energy efficiency (Janmaimool & Chontanawat, 2021). The primary goals of SEBs are to reduce CO_2 emissions and energy use. Alfaoyzan and Radwan (2022) have shown that the implementation of energy-efficient equipment significantly lowers campus energy consumption. Their analysis also highlights that reducing power use is a core component of most sustainable energy behaviors (SEBs) within the education sector.

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Literature has found that individual behavioral change is a more effective mechanism for reducing energy consumption and CO_2 emissions than adopting energy-efficient technologies Chiu et al. 2020). Students can achieve these reductions through practices such as disconnecting peripheral devices (e.g., LCD projectors), turning off lights after class, and powering down laptops. Iyiola and Mewomo (2022) have suggested that students can reduce energy consumption through specific behavioral modifications, such as turning off lights when leaving shared areas or corridors, unplugging unnecessary adapters, and keeping desk lamps off when not in use. Daiva et al. (2019) have noted that students frequently fail to deactivate electrical devices in classrooms and other communal spaces on campus when they are not in use, which affects their energy use and, consequently, increases the institution's CO_2 emissions. Thus, students' attitudes toward sustainable energy utilization are a pivotal element in facilitating efficient energy use on college campuses and are widely recognized as a substantial barrier to attaining a sustainable campus.

Determinants Influence Students' Adoption of Environmental Behaviors

The decision-making process for energy-saving behavior in higher education institutions is a significant subject for researchers, as it contributes favorably to establishing a sustainable campus (Heib et al., 2023; Malatesta et al., 2023). Heib et al. (2023) have found that students' inclination to adopt energy-saving measures on German university campuses is significantly affected by their normative beliefs and perceived behavioral control. Malatesta et al. (2023) have reported a positive association between organizational influence and increased awareness of the perceived use of energy-saving techniques, as well as the adoption of novel, low-carbon approaches. Costs and behaviors related to energy consumption are linked to awareness of energy conservation techniques and the detrimental impacts of climate change (Liu et al., 2023). Janmaimool and Chontanawat (2021) have indicated that undergraduate students are less inclined to adopt new techniques due to insufficient knowledge and ambiguity regarding the associated costs. The behavior of students is determined by their comprehension, attitudes towards electricity, and personal convictions. Consequently, providing students with pertinent knowledge concerning environmental problems, outlining their potential impacts, and offering specific coping strategies effectively facilitates the adoption of pro-environmental behaviors (Iyiola & Mewomo, 2021; Janmaimool & Chontanawat, 2021). Iyiola and Mewomo (2021) have stated that students' views and socioeconomic level impact their attitudes toward environmental concerns. Dumciuviene et al. (2019) have found that socio-demographic and psychological variables directly influence students' intentions, potentially enhancing their propensity to adopt improved energy-saving habits. Consequently, the extant research findings regarding students' pro-environmental decision-making within the context of sustainable campus development remain empirically inconsistent and ambiguous (Table 1).

Table 1
Literature on Energy-Saving Behavior by Students

Literature	Context	Subject	Theoretical basis	Expanded drivers	Significant results
Heib et al., (2023)	Energy conservation	Universities in Germany	TPB	Energy-saving behavior	Personal norm, behavioral control, and organizational influence were identified as significant factors for the intention.
Liu et al., (2023)	Energy-saving practices	University students in China	TPB	Energy-saving behavior	Environmental concerns have adverse effects. Energy-saving costs, habits, and subjective norms significantly influence.
Babatunde et al., (2023)	Sustainable energy conservation intention	University students in Malaysia	TPB	Energy-saving behavior	Social norms and perceived control significantly influence students' behavior.
Ma (2022)	Improve energy efficiency and energy flexibility	College students in Denmark	SEM	Energy control behavior	Aware of energy control, energy flexibility strategies have a significant effect.
Xng et al., (2022)	Energy saving in public buildings on campus	College students in China	SEM	Energy-saving intention	Perceived benefit, perceived value, and personal norm have a significant effect.

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Literature	Context	Subject	Theoretical basis	Expanded drivers	Significant results
Iyiola & Mewomo, (2021)	Electricity use behavior in halls of residence	College Students in Nigeria	SEM	Electricity use behavior	Awareness, personal beliefs, attitude towards electricity, and financial costs impact behavior.
Janmaimool & Chontanawat, (2021)	Energy conservation behavior	Undergraduate students in Thailand	SEM	Energy-saving behaviors	Awareness of climate change, Social norms, self-efficacy, and self-responsibility are not significant factors in determining success.
Yang et al., (2020)	Behavioral intentions	College students in China	TPB	Energy-saving behavior	Perceptual control, self-efficacy, and individual characteristics negatively influence energy-saving behavior.
Shi et al., (2019)	Energy conservation behavior	College students in China	VBN	Sustainable energy consumption behavior	Personal values and beliefs about energy conservation are significant factors that influence behavior.
Dumciuviene et al. (2019).	Sustainable energy consumption in schools and residential buildings	Vocational college students in Greece	SEM	Energy-saving behavior	Socio-demographic, psychological, and social factors are positive predictors of energy-saving behavior.

The following objectives are recognized for the present study to address these research gaps:

1) Integrate TPB and VBN into a unified theoretical framework to construct a comprehensive model that provides a more profound and precise understanding of students' decision-making processes regarding energy conservation in the development of sustainable university campuses.
2) Assessing the relative importance of the proposed study model in comparison to the original TPB and VBN models.
3) Examine the moderating influence of energy-saving communication functionalities within the proposed theoretical framework.
4) Ascertain which feature in the suggested model is more significant in forecasting students' desire to save energy.
5) Explore the research variables' mediation function in students' decision-making regarding energy conservation.

Research Model and Hypotheses

Value Belief Norm

The Value belief norm (VBN) facilitates the examination of normative components that support sustainable attitudes and actions (Stern et al., 1999; Stern, 2000). VBN framework is theoretically grounded in three distinct but integrated components: norm-activation theory, the new environmental paradigm (Dunlap et al., 2000), and Schwartz's (1992) value theory. Schwartz (1992) has defined a value as "a necessary trans-situational objective that varies in significance, serving as a guiding principle in the life of an individual or societal unit." Values indirectly influence behavior by shaping and altering perceptions of information that aligns with those values (Shi et al., 2019). VBN supports the causal model that advances from personal values (biospheric, altruistic, and egoistic) to the new environmental paradigm, awareness of consequences, attribution of responsibility, pro-environmental personal standards, and eventually, pro-environmental actions.

VBN theory establishes robust generalizability, proving effective in clarifying self-reported behavior and predicting a wide range of environmental behaviors and cognitions across diverse global contexts. Empirical instances of its predictive power encompass the adoption of sustainable energy conservation objectives (Shi et al., 2019), choices related to eco-friendly transportation (Linda et al., 2014), and general sustainable practices (Steg et al., 2018). Chen (2015) has presented that VBN can precisely predict the comprehensive environmental behavior of Taiwanese, including their support for ecologically beneficial governmental policies and participation in environmental groups. Stern et al. (1999) have categorized the environmental behaviors of US consumers into three distinct dimensions utilizing VBN theory: consumer behavior (frequency of purchasing eco-friendly products),

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readiness to compromise (willingness to allocate significant funds in taxes for environmental protection), and environmental citizenship (financial contributions to environmental organizations or signing petitions advocating for environmental preservation). VBN also demonstrates robust explanatory power across diverse geographical and behavioral contexts. It has been instrumental in explaining energy policies' acceptance in the Netherlands (Steg et al., 2018), self-reported energy conservation behaviors in Tunisia (Ibtissem, 2010) and Turkey (Sahin, 2013), and the intention to modify car usage behavior across five European nations (De Groot & Steg, 2010) and Argentina (Jakovcevic & Steg, 2013).

VBN states that structural characteristics of values precede beliefs and actions. The three dimensions of environmental values - egoistic, altruistic, and biospheric - affect people's views regarding environmental impacts, referred to as issue awareness (Stern, 2000). Altruistic individuals evaluate the environment based on its impact on others, such as the community, whereas biospheric individuals value the environment for its intrinsic importance (Stern & Dietz, 1994). Egoistic individuals evaluate their surroundings based on the direct effects on themselves.

De Groot and Steg (2009) have identified a positive correlation between a perceived moral obligation to reduce automobile use and the acceptance of transportation laws. This ethical imperative stems from the recognition of the environmental consequences associated with automobile usage and the corresponding acknowledgment of responsibility for the resulting ecological damage. According to the findings of Eriksson et al. (2008), a positive correlation is present between the adoption of diverse transport policy efforts and personal norms, problem awareness, and commitment to sustainability. Hirstuka et al. (2018) have asserted that biospheric values significantly influence problem awareness among Japanese automobile consumers. Yildirim and Semiz (2019) have found that biospheric values influence the recognition of water conservation behaviors when evaluating the VBN hypothesis. According to Landon et al. (2018), altruistic, biospheric, and egoistic values help elucidate knowledge of problems related to pro-sustainable activities.

Students initially perceive participation in energy-saving practices as a self-serving (egoistic) value; however, their engagement ultimately fosters the establishment of a sustainable campus (altruistic value) (Iyiola & Mewomo, 2008). In this scenario, the students proactively engaged in environmentally beneficial actions (biospheric value), aiding their peers and the authorities in establishing a sustainable campus with heightened problem awareness. Consequently, it is logical to infer that knowledge of the issue in energy-saving initiatives is likely affected by egoistic, biospheric, and altruistic values. Dumciuviene et al. (2019) have utilized the VBN to examine the establishment of sustainable energy consumption in schools and the decision-making processes for residential construction options from the perspective of energy preservation. The study findings reveal that students' desire to choose sustainable school campuses and residential structures is mainly affected by their understanding of the issue. The phrase "energy-saving responsibility" denotes students' awareness of the detrimental consequences of ecologically irresponsible behavior (Hirstsuka et al., 2018). A dedication to energy-saving practices is evident in the habitual execution of actions such as deactivating the air conditioner or modifying school activities to minimize energy use (Stern & Dietz, 1994). Nonetheless, the correlations among the variables in the VBN often provide dependable statistical inferences.

H1. Biospheric value significantly influences problem awareness.
H2. Altruistic value significantly influences problem awareness.
H3. Egoistic value significantly influences problem awareness.
H4. Problem awareness significantly influences energy-saving responsibility.
H5. Energy-saving responsibility significantly influences the feeling of commitment to energy-saving actions.
H6. The feeling of commitment to energy-saving actions significantly influences energy-saving behavior.

Theory of Planned Behavior

The Theory of Planned Behavior posits that an individual's engagement in a specific behavior is evaluated based on three key constructs: attitudes (ATT), subjective norms (SN), and perceived behavioral intention (PBC) (Fishbein & Ajzen, 1977). Attitude indicates people's perceptions of the consequences associated with a specific behavior, which are then evaluated in relation to those outcomes (Ajzen, 1991; Fishbein & Ajzen, 1977). The subjective norm is shaped by a person's normative views, as assessed by their motivations to adhere to regulations. Perceived behavioral control refers to an individual's belief in his/her ability to perform a given behavior successfully (Fishbein & Ajzen, 1977).

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TPB serves as a comprehensive theoretical model in pro-environmental behavior studies, effectively contributing to a better understanding of individuals' intentions toward prosocial activities (Dutta & Hwang, 2021; Yang et al., 2020). Heib et al. (2023) have found a positive correlation between energy-saving behaviors of German students and their attitudes, subjective norms, and perceived behavioral control.

H7. Attitude toward energy saving positively influences energy-saving behavior.
H8. Subjective norms have a positive influence on energy-saving behavior.
H9. Perceived behavioral control positively influences energy-saving behavior.

Converging Two Theoretical Frameworks

Socio-psychological factors consistently demonstrate superior predictive capability for pro-environmental behaviors when compared to socio-demographic variables (Ifegbesan et al., 2022). The rich association between an individual's environmental orientation (values, attitudes, and beliefs) and the subsequent cognitive and affective processes that govern their environmental actions forms a key theoretical precedent (Mohiuddin et al., 2018; Wyss et al., 2022). However, to overcome inherent limitations and improve predictive accuracy, the VBN is often synergistically integrated with prominent attitude models, TPB (Fishbein & Ajzen, 1977). Han (2015) has successfully combined VBN and TPB into a unified theoretical framework. This strategy aligns with recommendations of Steg et al. (2015) and has empirically demonstrated a superior predictive capacity for pro-environmental activities compared to the VBN when used in isolation. Consequently, the documented empirical utility of VBN in explaining a broad scope of environmental conduct provides a strong justification for its adoption and subsequent integration into the current study.

Despite its widespread acceptance, TPB faces academic scrutiny due to its omission of social influence and moral obligations, which are critical factors in pro-environmental decision-making (Chai et al., 2020; Leong et al., 2023; Steg et al., 2015). Integrating the TPB with the VBN model effectively addresses this gap, as the VBN incorporates environmental values and beliefs that impact both humans and their environment (Han, 2015). For instance, an individual's sense of environmental conservation is influenced by his/her belief that all humans share responsibility for the environment (Steg et al., 2015). Furthermore, TPB often neglects the frequency of behavior, yet energy-saving necessitates repetitive actions rather than one-time acts (Leong et al., 2023). Therefore, the practical leverage of moral and social norms, provided by the VBN theory, is vital for predicting holistic and sustained changes in pro-environmental behavior.

Within the VBN framework, Problem Awareness, often referred to as Consequence Awareness (Stern, 2000), serves as a fundamental prosocial construct that underlines the adoption of energy-saving behaviors. Greater awareness of environmental consequences is associated with better assistance to peers and engaging in cooperative actions (Steger et al., 2021). This recognition fosters a positive predisposition among students toward energy-saving practices (Liu et al., 2023). Furthermore, this awareness helps to mitigate external social pressures (Shi et al., 2019) and facilitates students' ability to develop solutions to common behavioral barriers, such as insufficient resources or time limitations (Dumciuviene et al., 2019; Han, 2015).

H10. Problem awareness positively impacts attitudes toward energy conservation.
H11. Problem awareness significantly affects subjective norms.
H12. Problem awareness significantly impacts perceived behavioral control.

Moderating Role of Energy-Saving Communication

Energy-saving communication is defined as sharing knowledge and implementing strategies that promote energy-saving behavior. It is a critical factor in explaining pro-environmental behaviors, as it indicates an individual's understanding of environmental problems and their impact on nature and ecosystems (Liu et al., 2020). Diverse perspectives have been found in the literature regarding the relationship between energy-saving communication and pro-environmental activities (Akram et al., 2023). According to Song et al. (2022), the pro-environmental behaviors of users have been considerably predicted by energy-saving messages. Kuźniar et al. (2021) have indicated that consumers with better knowledge about energy-saving practices are more likely to allocate resources towards eco-friendly products and demonstrate a willingness to purchase ecologically friendly items.

Energy-saving communication, in the context of sustainable behavior, encompasses the dissemination of information related to the technical implementation, resulting consequences, and the diverse means and objectives associated with energy conservation initiatives. This study conceptualizes the perceived hedonic balance (the

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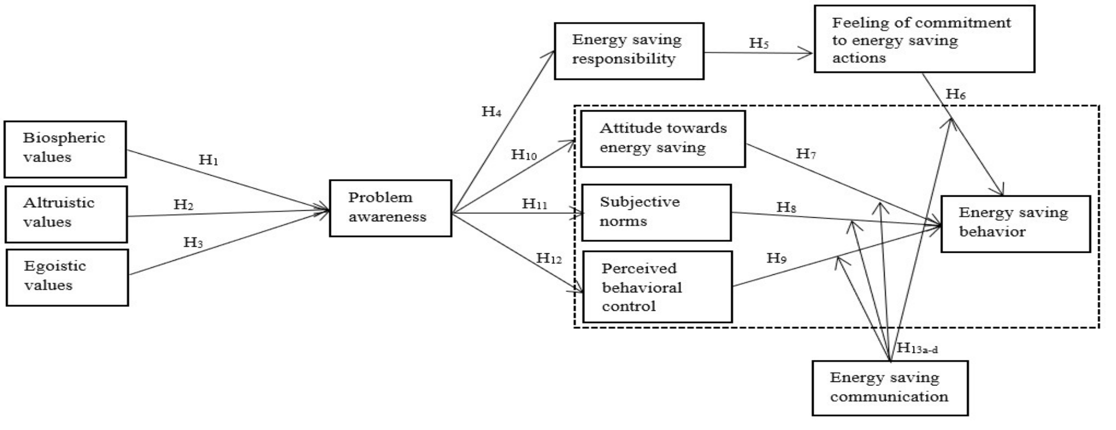
net positive and negative affective consequences anticipated from pro-environmental behaviors) as a dependent outcome of energy-saving communication. Since hedonism is a known motivation for student energy-saving participation (Shi et al., 2019), effective communication is expected to modulate the hedonic outcome and influence succeeding behavioral responses (Hirstsuka et al., 2018). Specifically, if a student perceives the energy-saving action as enjoyable and morally commendable, their moral obligation to participate has been strengthened (Akram et al., 2023). Conversely, negative experiences weaken the correlation between an individual's dedication and actual energy-saving behavior (Liu et al., 2020). This finding presents a key limitation for the TPB: even if students have better subjective norms and perceived behavioral control, their action may be hindered if their attitude is diminished by the perception that the effort is not worthwhile.

H13a. Energy-saving communication moderates the relationship between the feeling of commitment to energy-saving actions and energy-saving behavior.
H13b. Energy-saving communication moderates the relationship between ATT and energy-saving behavior.
H13c. Energy-saving communication moderates the relationship between SN and energy-saving behavior.
H13d. Energy-saving communication moderates the relationship between PBC and energy-saving behavior.

Figure 1
Research Framework



Research Methodology

General Background

The survey was administered online between November 15 and December 25, 2023. Before data collection, the author consulted with academics who had experience in questionnaire design to ensure the quality and effective distribution of the instrument. Based on ethical guidelines, all potential participants were provided with informed consent forms and detailed information sheets outlining the key objectives of the research (Kadam, 2017). Participants were assured of their right to withdraw from the study at any point. A brief description of security and data storage protocols was presented to alleviate potential concerns regarding data protection and to mitigate knowledge gaps related to information security (Manti & Licari, 2018).

Approval from the institutional review board (IRB) was not necessary for this research, as the data collection focused exclusively on participants' knowledge and comprehension of energy-saving behaviors and did not involve gathering sensitive personal information, physical characteristics, genetic data, or psychiatric illness status. A five-point Likert scale, ranging from "strongly disagree" to "strongly agree," was used to assess participants' knowledge regarding energy-saving behaviors. Finally, a concise overview of the energy-saving program was provided to participants. This contextual information was served for two purposes: first, to alleviate student skepticism rooted in the hedonistic nature of the subject; and second, to ensure a comprehensive understanding of how energy-efficient practices contribute to the overarching goal of creating a sustainable campus.

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Instrument and Procedures

AMOS, a statistical tool, was used to analyze data. Cronbach's alpha, composite reliability, and factor loadings are used to evaluate the reliability of measurement scales. Convergent validity is analyzed using average variance extracted (AVE), and discriminant validity is assessed by examining the square root of the AVE. The study's hypotheses are tested using Structural equation modeling (SEM), a methodology chosen because it effectively removes observational errors from the measurement of latent variables (Hair et al., 1998).

Sample

The study's target population consisted of undergraduate and graduate students. They were selected due to their direct influence on sustainable campus development. A convenience sampling strategy was employed to recruit participants. This approach was chosen as a pragmatic option to facilitate efficient data collection, allowing for initial trend analysis and hypothesis testing within cost and time constraints (López, 2023).

Data collection occurred over a period of four weeks, during which 492 students were approached for participation. A total of 418 students responded; however, seven surveys were deemed unusable due to incompleteness. This resulted in a final dataset of 411 relevant responses, representing an 80% response rate. Table 2 presents the demographic data. The distribution of participants across educational levels is broadly consistent with the actual demographics of the student population in Taiwan. Of the total sample, sixty percent (60%) were enrolled in undergraduate programs, while ten percent (10%) were graduate students. This distribution precisely reflects the higher enrollment rates typically observed in undergraduate programs compared to graduate programs within the national education system.

Table 2
Sample Demographics

Variable	Type	*N*	%
Gender	Male	208	50.68
	Female	203	49.32
Age	18–25	268	65.16
	26-31	126	30.62
	>31	17	4.22
Education	First-year	124	30.12
	Second-year	107	26.08
	Third-year	97	23.52
	Fourth/Final-year	83	20.28
Accommodation	Dormitory	198	48.24
	Rental house	107	26.12
	Own house	64	15.45
	Others	42	10.19

Data Distribution

Given the sample size of 411 valid responses, the Shapiro-Wilk test was utilized to assess data normality, a practice recommended for datasets with fewer than 2,000 items (Hair et al., 1998). The Shapiro-Wilk test results (Table 3) indicate that the *p*-values ranged from .310 to .394, confirming that the data are consistent with a normal distribution and rejecting the alternative hypothesis.

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Table 3
Distribution of Data

Determinants	Shapiro–Wilk		
	Shipiro-Wilk test statistic	*df*	Significance (*p*-value)
Energy-saving behavior	.952	457	.342
Biospheric values	.834	445	.358
Altruistic values	.914	438	.322
Egoistic values	.872	426	.310
Problem awareness	.828	451	.318
Energy-saving responsibility	.834	422	.328
Feeling of commitment to energy-saving actions	.826	474	.334
Attitude toward energy saving	.862	472	.348
Subjective norms	.908	464	.372
Perceived behavioral control	.818	418	.356
Energy-saving communication	.812	438	.394

Note. df = Degrees of freedom

Research Results

Common Method Bias

Addressing potential Common method bias (CMB) resulting from self-reported data, which incorporates social desirability effects, two key statistical tests were performed. Harman's Single-Factor Test indicates that the single factor accounted for only 24.7% of the total variance, well below the 50% threshold. Furthermore, the Full Collinearity test confirms that all Variance Inflation Factor (VIF) values are significantly below the suggested cutoff of 3.3, thereby, it demonstrates that CMB does not significantly undermine the validity of the stated findings (Table 4).

Table 4
Collinearity Assessment

Variable	Random Dummy variable
Biospheric values	2.136
Altruistic values	1.939
Egoistic values	1.646
Problem awareness	1.545
Energy-saving responsibility	1.432
Feeling of commitment to energy-saving actions	2.237
Attitude toward energy saving	1.720
Subjective norms	1.652
Perceived behavioral control	1.667
Energy-saving behavior	1.562
Energy-saving communication	1.864

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Reliability and Validity

The internal consistency of the model was measured by composite reliability (CR) and Cronbach's alpha. The range of Cronbach's alpha (α) and Composite reliability varies from .814 to .879 and .738 to .814, respectively, higher than the suggested value of .70 by Hair et al. (1998), implying reasonable reliability and consistency (Table 5). Convergent validity was assessed using three criteria proposed by Hair et al. (1998): (1) each indicator's loadings are greater than .70; (2) the CR values are greater than .70; and (3) AVE is greater than .50. As shown in Table 5, the factor loadings of each indicator and the CR values exceed the suggested .70 threshold. Furthermore, the AVE values range from .65 to .72 (Table 5), exceeding the suggested value of .50. Thus, all three conditions of convergent validity are satisfied.

Table 5
Each Determinant's Mean, Standard Deviation, and Factor Loadings

Construct	*M*	*SD*	Factor Loadings	AVE	*α*	CR
Biospheric values						
BIV1	3.15	0.94	.885	.772	.862	.762
BIV2	3.20	0.96	.862			
BIV3	3.27	1.04	.825			
BIV4	3.15	0.93	.852			
Altruistic values						
ALV1	3.13	0.97	.850	.665	.846	.758
ALV2	3.21	1.01	.812			
ALV3	3.29	0.91	.822			
ALV4	3.18	0.95	.854			
Egoistic values						
EGV1	3.10	0.91	.842	.770	.856	.738
EGV2	3.14	1.03	.820			
EGV3	3.21	0.95	.812			
EGV4	3.11	0.92	.841			
Problem awareness						
PRA1	3.09	0.93	.808	.682	.814	.742
PRA2	3.11	1.02	.824			
PRA3	3.19	0.95	.818			
Energy-saving responsibility						
ESR1	3.14	0.97	.812	.692	.842	.764
ESR2	3.15	1.01	.819			
ESR3	3.22	0.92	.818			

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Construct	*M*	*SD*	Factor Loadings	AVE	*α*	CR
Feeling of commitment to energy-saving actions						
FSA1	3.11	1.03	.815	.765	.879	.752
FSA2	3.12	0.92	.820			
FSA3	3.16	1.01	.819			
Attitude toward energy saving						
ATT1	3.17	1.04	.816	.672	.864	.814
ATT2	3.15	0.91	.813			
ATT3	3.23	1.03	.823			
ATT4	3.19	0.92	.849			
Subjective norms						
SN1	3.10	1.05	.818	.681	.848	.756
SN2	3.18	1.02	.834			
SN3	3.23	0.97	.826			
SN4	3.13	0.93	.815			
Perceived behavioral control						
PBC1	3.17	0.91	.799	.659	.836	.748
PBC2	3.16	0.93	.818			
PBC3	3.23	0.92	.851			
PBC4	3.19	0.95	.794			
Energy-saving communication						
ESC1	3.15	0.89	.824	.716	.824	.746
ESC2	3.13	0.95	.817			
ESC3	3.18	0.94	.830			
ESC4	3.11	0.91	.824			
ESC5	3.17	0.97	.846			
Energy-saving behavior						
ESB1	3.12	0.91	.927	.657	.828	.754
ESB2	3.16	0.95	.836			
ESB3	3.22	0.96	.921			
ESB4	3.16	0.91	.865			

Discriminant Validity

Discriminant validity was assessed using the criteria proposed by Fornell and Larcker (1981), where AVE (average variance extracted) of each construct should outperform its maximum squared correlation with any other construct in the model. Table 6 reveals that AVE values for all latent variables are consistently greater than

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their respective maximum shared variance (i.e., the squared inter-construct correlation). Thus, the condition of convergent validity is satisfied.

Table 6
Discriminant Validity

	BIV	ALV	EGV	PRA	ESR	FSA	ATT	SN	PBC	ESC	ESB
BIV	**.878**										
ALV	.464	**.815**									
EGV	.482	.468	**.877**								
PRA	.552	.607	.456	**.825**							
ESR	.334	.453	.287	.514	**.831**						
FSA	.615	.356	.523	.521	.326	**.874**					
ATT	.443	.474	.518	.373	.468	.456	**.819**				
SN	.312	.506	.283	.651	.356	.524	.512	**.825**			
PBC	.283	.556	.371	.462	.524	.474	.337	.459	**.811**		
ESC	.357	.412	.312	.428	.416	.410	.358	.398	.406	**.846**	
ESB	.456	.376	.351	.486	.282	.476	.367	.458	.426	.468	**.810**

Structural Equation Modeling

Goodness-of-fit of the proposed model indicates that it is a good fit for the data (χ^2 = 1182.297, *df*= 419, *p*< .001, RMSEA= .079, CFI= .906, IFI= .907, NFI= .861, PGFI= .681). Before the proposed relationships are tested, the current model is compared against original VBN (χ^2=778.305, *df* = 193, *p* < .001, RMSEA =.089, CFI = .867, IFI = .879, NFI = .856, PGFI = .649) and TPB (χ^2=206.142, *df* = 61, *p* < .001, RMSEA =.087, CFI = .915, IFI = .914, NFI = .886, PGFI = .571) models. This comparison is conducted to empirically determine whether the proposed integrated model offers superior predictive power for energy-saving behavior. The proposed model (χ^2/df = 2.821) exhibits a superior fit compared to both VBN (χ^2/df = 4.032) and TPB (χ^2/df = 3.379), a finding consistent with other goodness-of-fit measures (Table 7). Moreover, the proposed model demonstrates a better predictive capability for intention (R^2 = .638) compared to VBN (R^2 = .449) and TPB (R^2 = .498). A Chi-square difference test further confirms that the proposed model performs significantly better than both VBN ($\Delta\chi^2$= 459.312, *p* < .01) and TPB ($\Delta\chi^2$= 891.216, *p* < .01) (Table 7).

Table 7
Comparisons of the Proposed Model against VBN and TPB

Goodness-of-fit & R2	VBN	TPB	Proposed model
Fit indices			
χ^2	778.305	206.142	1182.297
df	193	61	419
χ^2/df	4.032	3.379	2.821
RMSEA	.089	.087	.079
CFI	.867	.915	.906
IFI	.879	.914	.907

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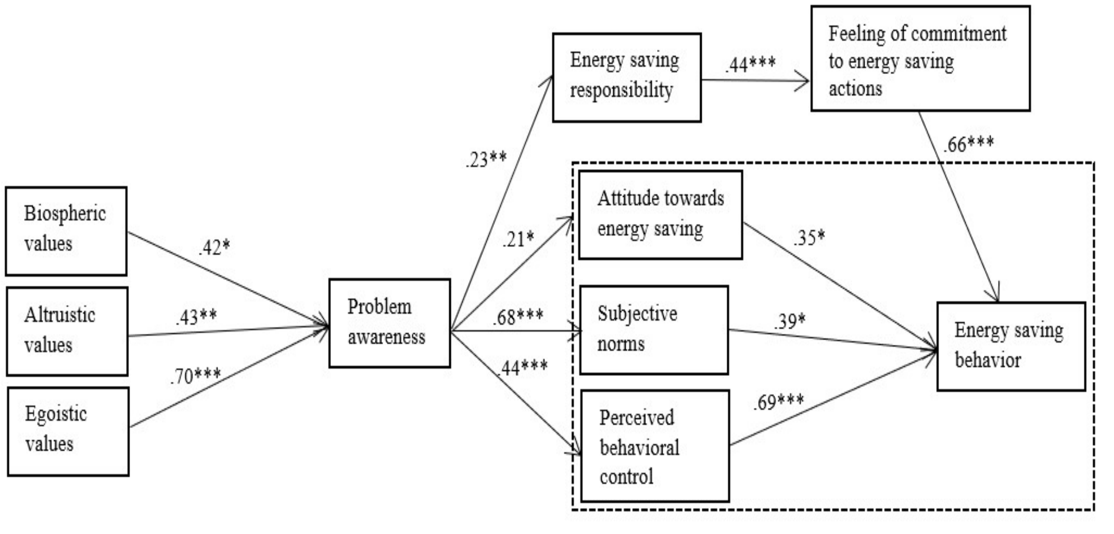
Goodness-of-fit & R2	VBN	TPB	Proposed model
NFI	.856	.886	.861
PGFI	.649	.571	.681
	R2 (Adjusted):		
Energy Saving Behavior	.449	.498	.638

Chi-square test: Proposed model vs. VBN: $\Delta\chi^2$= 459.312, p < .01.
Chi-square test: Proposed model vs. TPB: $\Delta\chi^2$= 891.216, p < .01.

Table 8 summarizes the SEM findings, which demonstrate that all the proposed relationships are supported (Figure 2).

Figure 2
Structural Equation Modelling



χ^2= 845.546, df=426, p<.001, χ^2/df=1.98, RMSEA = .047, CFI = .92, IFI= .92, and TLI = .91.

Table 8
Hypotheses Test's results

Path	Estimate	t-value	Hypothesis	Result
BIV → PRA	.427	4.456	H1	Supported
ALV → PRA	.437	4.279	H2	Supported
EGV → PRA	.705	8.767	H3	Supported
PRA → ESR	.235	3.447	H4	Supported
ESR → FSA	.441	4.468	H5	Supported
FSA → ESB	.672	7.962	H6	Supported
ATT → ESB	.356	3.982	H7	Supported
SN → ESB	.398	4.128	H8	Supported
PBC → ESB	.698	8.156	H9	Supported

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Path	Estimate	t-value	Hypothesis	Result
PRA → ATT	.216	3.275	H10	Supported
PRA → SN	.686	8.062	H11	Supported
PRA → PBC	.443	4.482	H12	Supported

Indirect effects within the structural model are subsequently assessed to evaluate the mediating roles of the constructs. The findings (Table 9) reveal significant indirect influences on energy-saving behavior. Specifically, significant indirect effects are found for biospheric values (β= .07, $p < .05$), altruistic values (β= .18, $p < .01$), egoistic values (β= .26, $p < .01$), problem awareness (β= .38, $p < .001$), and energy-saving responsibility (β= .12, $p < .001$). These findings collectively demonstrate that the proposed mediating variables significantly transmit the effects of the antecedent VBN and related constructs onto the energy-saving behavioral outcome.

Table 9
The Results of the Indirect Effect on Energy Saving Behavior

Variance explained		Total effect on ESB	Indirect effect on ESB
R^2 (PRA) = .22	R^2 (ATT) = .23	β_{FSA} = 16***	β_{BIV} → PRA/ESR/ATT/SN/PBC/ FSA → ESB=.07*
R^2 (FSA) = .58	R^2 (PBC) = .17	β_{ATT} = 28***	β_{ALV} → PRA/ESR/ATT/SN/PBC/ FSA → ESB=.18**
R^2 (SN) = .12		β_{SN} = 33***	β_{EGV} → PRA/ESR/ATT/SN/PBC/ FSA → ESB=.26**
R^2 (ESB) = .56		β_{PBC} = 18***	β_{PRA} → ESR/ATT/SN/PBC/ FSA → ESB=.38***
R^2 (ESR) = .47			β_{ESR} → FSA → ESB=.12***

Moderating Effect

The moderation effect of energy-saving communication was examined using the chi-square difference test, as proposed by Singh (1995) and Awang (2015). The chi-square difference test between the unconstrained and constrained models (Table 10) shows that the relationship between the feeling of commitment and behavior is significantly moderated ($\Delta\chi^2 = 118.814$, $\Delta df = 1$). Thus, hypothesis 13a is supported, as it demonstrates that higher energy-saving communication (Group 2) strengthens the positive effect of the feeling of commitment to energy-saving behavior compared to lower energy-saving communication (Group 1). The chi-square difference test between the unconstrained and constrained models reveals that the relationship between attitude and energy-saving behavior is significantly moderated ($\Delta\chi^2 = 28.59$, $\Delta df = 1$) (Table 10). Thus, hypothesis 13b is supported as it demonstrates that higher energy-saving communication (Group 2) positively influences energy-saving behavior compared to lower energy-saving communication (Group 1).

The relationship between subjective norms and energy-saving behavior is significantly moderated ($\Delta\chi^2 = 44.69$, $\Delta df = 1$), as indicated by the chi-square difference test between the unconstrained and constrained models (Table 10); thus, hypothesis 13c is supported as it demonstrates a higher level of energy-saving communication (Group 2) was found to significantly strengthen the positive relationship between subjective norms and energy-saving behavior, relative to a lower level (Group 1). Finally, the relationship between PBC and energy-saving behavior is significantly moderated ($\Delta\chi^2 = 56.80$, $\Delta df = 1$), as shown by the chi-square difference test (Table 10); thus, hypothesis 13d is supported as it demonstrates that a higher level of energy-saving communication (Group 2) exhibited a stronger positive correlation with energy-saving behavior than its lower-level counterpart (Group 1).

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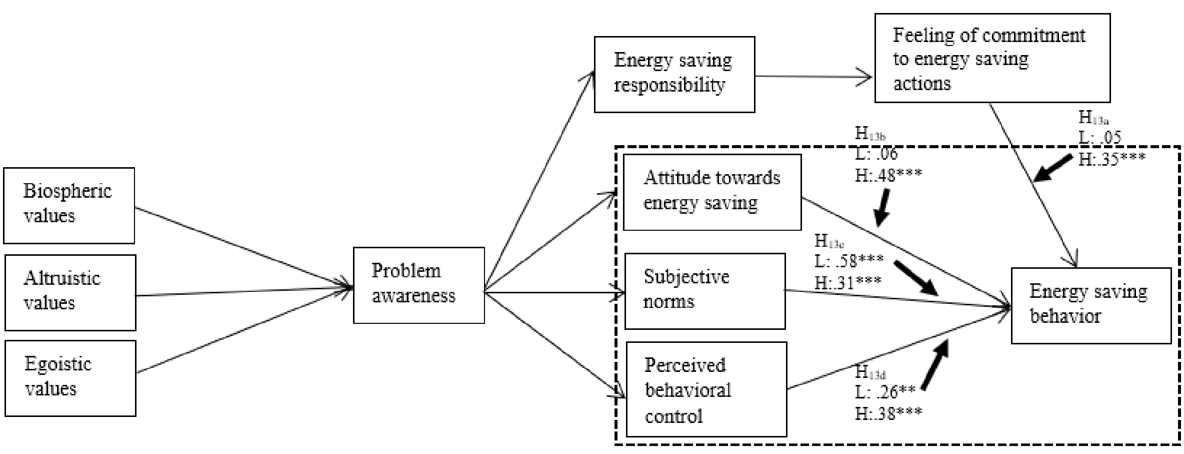
Table 10
The Results of the Moderating Effect

Model	χ^2	*df*	$\Delta\chi^2$ (Δdf)	Chi-Square (χ^2) Critical Value
Unconstrained model	1097.682	230		χ^2 (1,1.07) = 3.76
Constrained model (FSA → ESB)	1216.496	231	118.814(1)	
Constrained model (ATT → ESB)	1126.280	231	28.598(1)	
Constrained model (SN → ESB)	1142.378	231	44.696(1)	
Constrained model (PBC → ESB)	1154.490	231	56.808(1)	
Path		Estimate	S.E.	***t*-value**
FSA → ESB	Group1	.051	.067	1.473
	Group2	.357	.165	3.271
ATT → ESB	Group1	.069	.162	1.682
	Group2	.486	.262	6.562
SN → ESB	Group1	.581	.072	5.161
	Group2	.315	.365	2.526
PBC → ESB	Group1	.261	.213	2.245
	Group2	.384	.268	4.982

Note. BIV= Biospheric values, EGV= Egoistic values, PRA= Problem awareness, ESR= Energy saving responsibility, FSA= Feeling of commitment to energy saving actions, ATT= Attitude towards energy saving, PBC= Perceived behavioral control, SN= Subjective norms, ESB= Energy saving behavior, ESC= Energy saving communication, Group1 = lower energy saving communication, Group2 = higher energy saving communication.

Figure 3
The Moderation Test's Outcomes



The moderation hypothesis is supported. The Moderation hypothesis is not supported.

Goodness-of-fit for the unconstrained model: χ^2 = 1097.682, *df* = 230, *p* < .001, RMSEA = .047, CFI = .90, IFI = .92, and TLI = .91.

Two identical models, one with low energy-saving communication and the other with high energy-saving communication, were assessed.

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Discussion

The aim of the current study was to develop and empirically test an integrated framework that combines TPB and VBN, with energy-saving communication as a moderator, to predict students' intentions toward energy-saving behaviors. The findings provide substantial support for the proposed model, offering several key interpretations that move beyond a simple restatement of the results.

Superiority and Rationale of the Integrated Framework

The empirical superiority of the integrated model (R^2 =.681) over its individual components (VBN R^2 =.449; TPB R^2 =.498) is one of the study's foremost conclusions. This result is not merely additive; it validates the synergistic necessity of both deep-seated moral foundations and proximal cognitive factors in predicting sustainable behavior. The VBN framework, rooted in biospheric, altruistic, and egoistic values, establishes the moral and personal predisposition toward conservation. However, this predisposition requires the actionable cognitive and social elements supplied by the TPB (Attitude, Subjective Norm, and Perceived Behavioral Control) to translate into a concrete intention. This structural integration, therefore, fills a critical gap in the literature that previously relied on comparing the two theories or adding VBN values without establishing a clear structural link (Han, 2015; Xing et al., 2022). Our finding corroborates the notion that the strongest behavioral prediction arises when both the will (VBN) and the way (TPB) are accounted for.

The Essential Mediating Function

The finding that problem awareness and personal norm (feeling of commitment) perform an essential mediating function between VBN constructs and TPB constructs offers a crucial interpretation regarding the activation process of values. Personal values, even those strongly held, are often too abstract to directly trigger behavior.

Problem Awareness acts as the necessary cognitive trigger, transforming an abstract value (e.g., "I value nature") into a concrete belief (e.g., "Energy waste harms nature"). This step aligns with the VBN chain (Schwartz, 1977), where awareness of consequences is the immediate precursor to moral obligation.

Personal Norm also provides the necessary moral compulsion. The significant mediation confirms that values are effective only once the individual feels personally obligated to act on the problem they have become aware of. This mechanism explains why past research has successfully extended VBN (Babatunde et al., 2023; Nordlund et al., 2016). The abstract initial motivation must be filtered through a conscious state of awareness and obligation before it influences the final intention.

Energy-Saving Communication: A Non-Uniform Moderator

The analysis of energy-saving communication's moderating role is perhaps the most novel and practically significant finding. The results clearly demonstrate that communication does not act as a uniform amplifier; rather, it possesses a dual mechanism of influence across the TPB variables. The results indicated that insufficient energy-saving communication negatively impacts a student's attitude toward the measures. This result is likely due to communication's role in establishing the perceived hedonic balance (Hirstsuka et al., 2018). Poor or nonexistent communication fails to adequately frame the behavior as enjoyable, morally commendable, or worthwhile, leading to a diminished positive evaluation and reinforcing the perception of effort or inconvenience. This suggests communication is essential for the emotional valuation of the act.

Conversely, effective communication demonstrated a strong positive influence on PBC. This is because communication provides the instrumental knowledge (how to act, where to act, and what the benefit is) that reduces the perception of inherent challenges. This effect corroborates the findings of Yang et al. (2020), but extends them by showing that communication's power lies in its ability to strengthen the perceived capability to act.

In synthesis, the moderation finding implies that communication serves both a motivational (hedonic/attitudinal) and an instrumental (PBC) function. A university can ensure students have the moral will (VBN) and the attitude, but if the communication is poor, it sabotages the student's confidence (PBC) and dampens the positive emotional response, thereby undermining the full conversion of intention into actual behavior.

The current study makes several significant contributions. While prior research has examined VBN and TPB models individually, the current study successfully integrates them into a singular framework to predict students'

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intentions toward energy-saving activities. This approach fills a critical gap in the literature, as previous work by Han (2015) primarily compared the two theories without establishing a clear structural link between them. Furthermore, Xing et al. (2022) expanded the TPB using VBN values; their study lacked constructs that accurately reflected the context of general energy-saving activities outside of campus public buildings. By successfully integrating these theories and expanding the original models, the current research provides an inclusive perception of the relationship between personal beliefs and social characteristics, thereby enhancing our understanding of students' objectives within the context of building a sustainable campus. Second, the key theoretical contribution of this study lies in its demonstration of the essential mediating function performed by problem awareness and personal norm (feeling of commitment) in articulating the relationship between the VBN and TPB constructs. The findings align with existing literature that has successfully extended personal values into the VBN framework, including studies on Norm Activation Theory in ecological activities (Schwartz, 1977), purchasing unleaded fuel (Nordlund et al., 2016), and energy-saving behaviors (Babatunde et al., 2023). Specifically, the critical mediating function of personal norm and awareness of consequences between personal values and behavioral intentions, previously noted in studies among young travelers (Kiatkawsin & Han, 2017) and eco-behaviors (Landon et al., 2018), is confirmed within this energy-saving context. Therefore, academic scholars and practitioners should acknowledge the impact of problem awareness on students' commitment, as this relationship is essential for effectively encouraging participation in sustainable campus initiatives.

Third, the current study offers a novel contribution, being the first to demonstrate, to the authors' understanding, the importance of energy-saving communication in influencing students' intentions toward achieving a sustainable campus through energy-saving behavior, to the authors' knowledge. Energy-saving communication has a strong moderating effect on all relationships, including those between TPB and energy-saving behavior, as well as the connection between feeling committed to energy-saving efforts and actual energy-saving behavior. It is worth noting that this strong moderation does not imply that students with better access to communication are necessarily more morally inclined. For instance, Paraskevaidis and Andriotis (2017) found that students may fail to consider the influence of personal norms, which include a sense of commitment to energy-saving behaviors, because they are primarily motivated by self-interested benefits, such as social recognition. Furthermore, psychological factors may prevent improved access to energy-saving communication from activating biospheric and altruistic values. Instead of genuinely improving the environment, individuals may be driven by egoism or a selfish desire for personal growth. In light of this, it remains necessary to investigate the specific mechanism that raises students' actual environmental awareness and how that awareness affects other motivational factors, even if energy-saving communication statistically serves as a significant moderator. This finding is supported by Liu et al. (2023), who found that value-action motivation variables (i.e., perceived personal responsibility) and cognitive and normative elements (i.e., subjective norm, self-efficacy, and collective efficacy) are effective predictors of pro-environmental behavior communication. Therefore, when evaluating students' intentions to create a sustainable campus through energy-saving behavior, researchers should explicitly consider the role of perceived personal benefits in overcoming purely altruistic motivations. Fourth, the analysis of energy-saving communication's moderating role revealed that its influence is not uniform; instead, it differentially affects the relationships between TPB variables and behavioral intention. Specifically, insufficient communication was found to have a negative impact on students' attitudes toward energy-saving measures, resulting in a lower positive evaluation of these measures. Consequently, this leads to a reduced intention to contribute to a sustainable campus. Conversely, effective communication demonstrated a positive influence on PBC by conveying a stronger sense of capability and reducing the perception of inherent challenges. This effect fosters the necessary confidence to overcome barriers and promotes active engagement in energy-saving behaviors.

The significant moderating effect of energy-saving communication between SN and energy-saving behavior implies that social influence is not uniformly effective in motivating student action. Specifically, the perceived social pressure or expectations from relevant others (parents, peers, faculty) are only optimally translated into actual behavior when effective communication channels are present. Universities should therefore prioritize communication strategies that not only disseminate technical information but also explicitly reinforce positive social expectations and frame energy conservation as a collective, socially valued behavior. This suggests that communication acts as a crucial amplifier for normative pressure, ensuring that students are not only aware of what they should do but are also motivated and informed enough to act on that social knowledge.

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Limitations

Despite its influential contributions, the current study has some limitations. A key methodological constraint is the use of convenience sampling, which recruited participants from a single university in Taiwan. While the approach is practical for initial model testing, it restricts the external validity of the results, since the particular cultural and institutional environment of the research location may affect the results. Consequently, the findings may not be fully representative of all students, and caution should be exercised when extrapolating the results to similar university settings. Therefore, future studies should employ a cross-cultural sampling design to rigorously test the external validity of the integrated model across different national and educational environments. A second limitation is the reliance on self-reported behavioral intention as the outcome variable. While our study is theoretically grounded in models (TPB/VBN) where intention is the most potent precursor to actual behavior, this measure is subject to potential social desirability bias. Therefore, future studies should utilize longitudinal designs or incorporate objective consumption data to corroborate the conversion of stated intentions into actual energy-saving behaviors. Finally, given the established utility of the integrated TPB and VBN model, there is a clear opportunity to expand its explanatory power by capturing a broader range of behavioral motivators. Specifically, future studies should move beyond the current focus on intrinsic values and explore the integration of extrinsic elements, such as monetary rewards or cost-saving incentives. Incorporating these tangible benefits into the current framework to improve the framework's scope and offer an inclusive consideration of how diverse motivations mutually influence pro-environmental behavior.

Conclusions and implications

The current study sheds light on the growing topic of students' engagement in energy-saving behaviors, offering specific and significant implications, as well as original and insightful information. It contributes to the literature by incorporating energy-saving communication as a moderator into the VBN and TPB framework, an approach that has not been explored in existing research. The results supported twelve proposed hypotheses. Additionally, this study identified the moderating role of energy-saving communication and achieved five research objectives. The findings demonstrate the mechanism through which problem awareness affects students' commitment to energy-saving behaviors, which in turn influences their involvement in developing a sustainable campus through the adoption of energy-saving practices. Furthermore, by effectively promoting universities' green initiatives and practices, the current research contributes to the existing literature on sustainable user behavior. Based on these insights, universities should prioritize the development of more effective communication policies designed to engage and influence students' pro-environmental behavior across voluntary, non-volitional, normative, and cognitive domains.

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Appendix

Questionnaire in English

Title of Study: Sustainable Campus for Sustainable Learning Development: Investigating Students' Energy-Saving Behavior.

You are being asked to participate in a research study. Before you give your consent to be a participant, it is important that you read the following information and ask as many questions as necessary to be sure that you understand what you will be asked to do or what you are going to do.

Investigators:

- Bireswar Dutta, Assistant Professor, English Taught Program in Smart Service Management, Shih Chien University.

Purpose of the Study:
The objective of this study is to explore the factors that influence students' intention to perform energy-saving behavior on the school campus. The target population of this study is composed of students who study in Taiwan.
Description of the Study:
You are being asked to complete the survey, which consists of 42 questions. The item aims to find your knowledge, perception, and attitude toward performing energy-saving behavior. All items are on a five-point Likert-type scale. It takes less than 25-30 minutes to complete this survey.
Risks or Discomforts:
If you feel uncomfortable at any time during participation in this survey, you can discontinue at any time, either temporarily or permanently.
Confidentiality:
You, as a participant, do not need to provide any private information such as your social ID, Health details, etc. You do not need to mention your name anywhere in the questionnaire. Thus, the current survey is entirely anonymous.
Questions about the Study:
If you have any questions regarding the current study, please do not hesitate to contact Mr. Bireswar Dutta at: bdutta67@g2.usc.edu.tw.

Agreement:
If you are interested in taking this survey, please select the "I Agree" choice and continue to take the survey; otherwise, select "I Do not Agree."

I Agree (1); I Disagree (2). If "I Disagree" Is Selected, Then Skip the rest of the pages.

***Thank You so much for your time and participation*.**

Q1: Gender:
Male
Female

Q2: Age:
18-25
26-31
More than 32

Q3: Education:
Freshman
Sophomore
Junior
Senior

Q4: Major:
Language
Management
Engineering
Others

Q2: Accommodation:
Dormitory
Rental house
Own house
Others

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No.	Items	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1	I think protecting the environment leads to preserving nature.					
2	I think preventing pollution leads to protecting natural resources					
3	I feel satisfied about the fact that respecting the earth leads to harmony with other species					
4	I like the idea that unity with nature leads to fitting into nature					
5	I think social justice helps to correct injustice and leads to care for the weak					
6	I believe the world should be at peace and free of war and conflict					
7	I believe everyone should get equal opportunity.					
8	I believe in working for the welfare of others					
9	I believe social power means control over others, dominance					
10	I think wealth means material possessions, money					
11	I think authority means the right to lead or command					
12	I think influential means having an impact on people and events					
13	I think current usage behavior (e.g., don't turn off the light in the classroom) can cause pollution					
14	I think current usage behavior (e.g., don't turn off the light in the classroom) can potentially have a negative impact on global warming					
15	I think current usage behavior (e.g., don't turn off the light in the classroom) can lead to environmental pollution					
16	Every student has a duty to take responsibility for the school environment.					
17	Every student would rather sacrifice his/her personal interests to protect the school environment.					
18	I have an obligation to discourage an energy-saving, friendly behavior.					
19	I feel ethically grateful to help others through an energy saving behavior.					
20	I feel a moral obligation to participate in an energy saving behavior to help other classmates.					
21	I feel a moral obligation to take altruistic action through an energy saving behavior.					
22	I think energy saving behavior helps lower pollution.					
23	I think energy saving behavior helps to preserve nature.					
24	I think I have a positive attitude toward performing energy saving behavior.					
25	Energy-saving behavior is important to reduce pollution on the school campus.					
26	I would say that behaving in an energy saving way is suitable.					

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No.	Items	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
27	I would say that behaving in an energy saving way is right.					
28	I would say that behaving in an energy-saving way will benefit me and other students.					
29	I would say that behaving in an energy saving way is compulsory					
30	I can participate in the decision-making process of behaving energy saving.					
31	I can decide whether to behave eco-friendly or not by myself.					
32	I am free to behave eco-friendly when I am on campus.					
33	I have resources, time, and opportunities to behave energy saving when I am on campus.					
34	I am happy about the level of information available regarding energy saving behavior.					
35	Media reports influence the students' views on energy saving behavior.					
36	The student understands the causes of climate change and its possible consequences through the media.					
37	The media affects students' concerns about climate change.					
38	The current level of information provided on energy-saving behavior is clear.					
39	I perform energy-saving behavior.					
40	I intend to perform energy-saving behavior in the future					
41	I perform energy-saving behavior to reduce pollution around the school campus.					
42	When I have an option between two behaviors, I intend to perform energy-saving behavior as it causes less harm to other classmates.					

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